Supporting Information for

Two New Layered Metal Chalcogenide Frameworks as Photocatalysts for Highly Efficient and Selective Dye Degradation

Sijie Wu,[a] Zhou Wu,[a] Xiao-Li Wang,[a] Xiang Wang,[a] Rui, Zhou,[a] Dong-Sheng Li[b] and Tao Wu[*,a]*

[a] College of Chemistry, Chemical Engineering and Materials Science, Soochow University, Suzhou, Jiangsu 215123, China.

[b] College of Materials and Chemical Engineering, Hubei Provincial Collaborative Innovation Center for New Energy Microgrid, Key Laboratory of Inorganic Nonmetallic Crystalline and Energy Conversion Materials, China Three Gorges University, Yichang, Hubei 443002, China.

* Corresponding author E-mail: wutao@suda.edu.cn

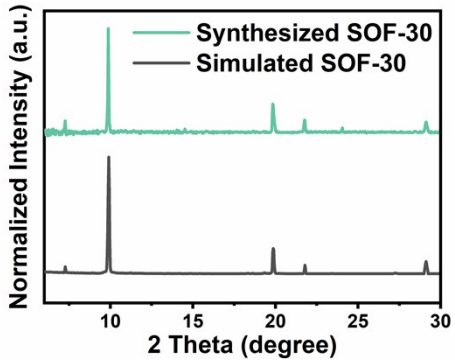

Figure S1. Powder X-ray diffraction (PXRD) patterns of as-synthesized **SOF-30** and its simulated one.

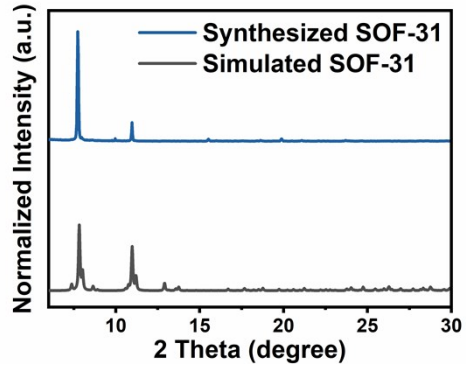

Figure S2. Powder X-ray diffraction (PXRD) patterns of as-synthesized **SOF-31** and its simulated one.

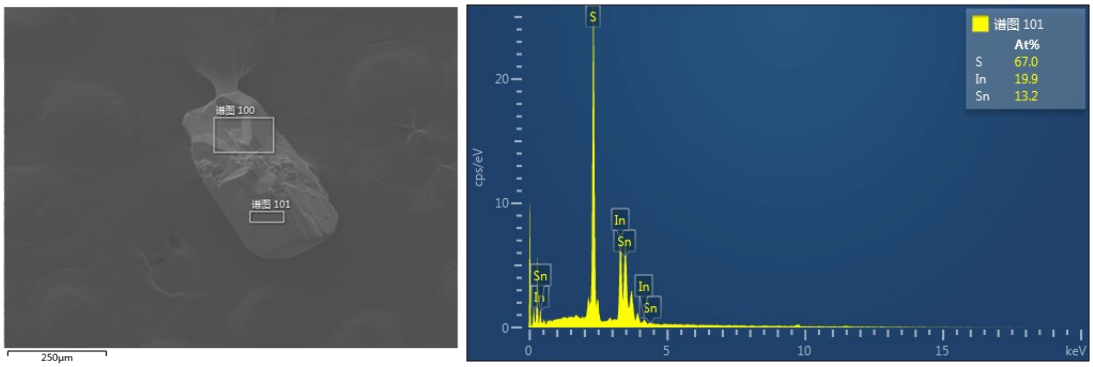

Figure S3. Left: SEM image of as-synthesized **SOF-30**. Right: EDS of **SOF-30**.

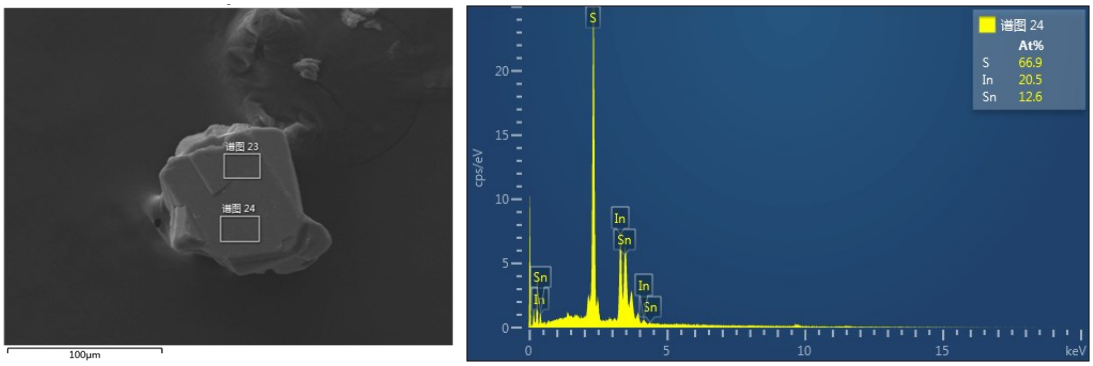

Figure S4. Left: SEM image of as-synthesized **SOF-31**. Right: EDS of **SOF-31**.

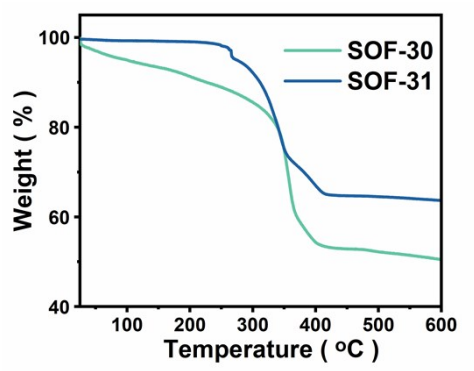

Figure S5. TG curves of **SOF-30** and **SOF-31**. The initial gradual weight loss of 15% and 8% between 30-100°C could be attributed to loss of moisture and solvent adsorbed on the surface of **SOF-30** and **SOF-31**. A further abrupt weight loss of 47% and 35% between 200-450°C are attributed to the carbonization of template of **SOF-30** and **SOF-31**, respectively.

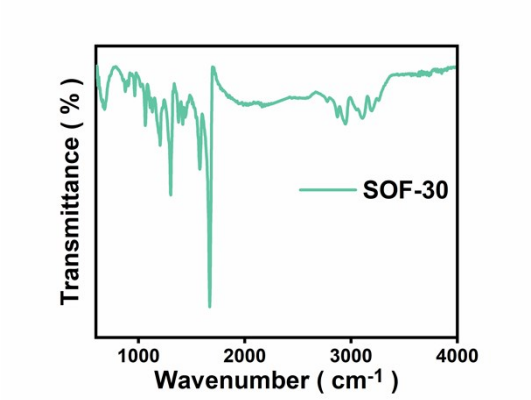

Figure S6. FT-IR spectrum of **SOF-30**.

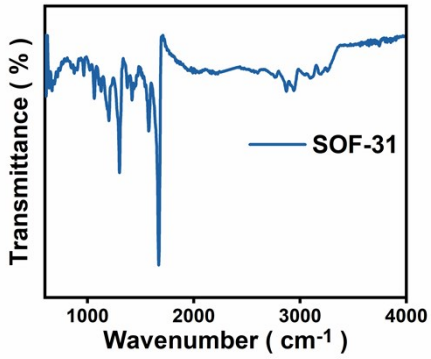

Figure S7. FT-IR spectrum of **SOF-31**.

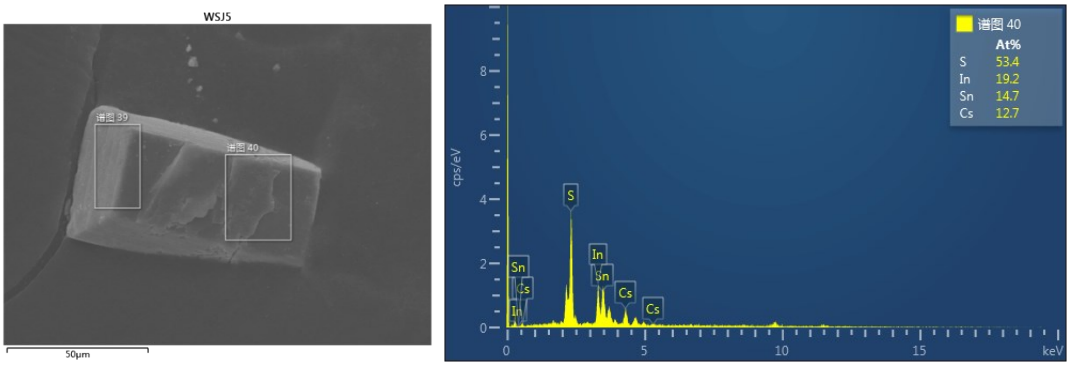

Figure S8. Left: SEM image of as-synthesized **Cs@SOF-30**. Right: EDS of **Cs@SOF-30**.

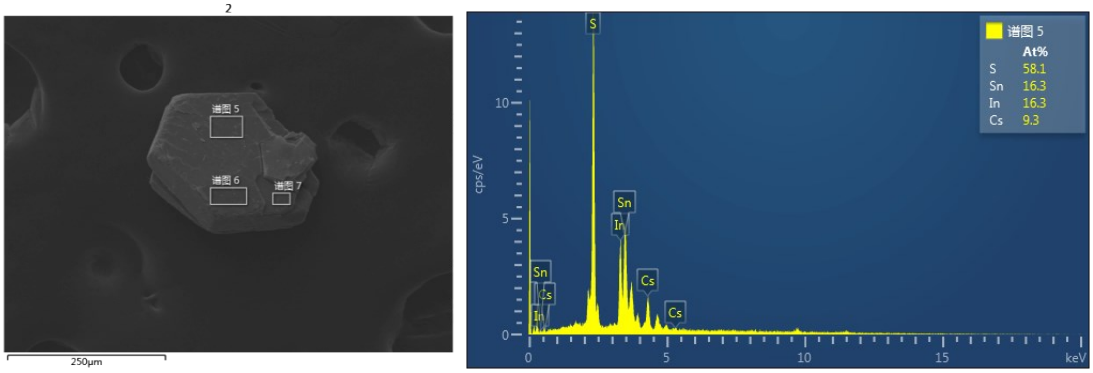

Figure S9. Left: SEM image of as-synthesized **Cs@SOF-31**. Right: EDS of **Cs@SOF-31**.

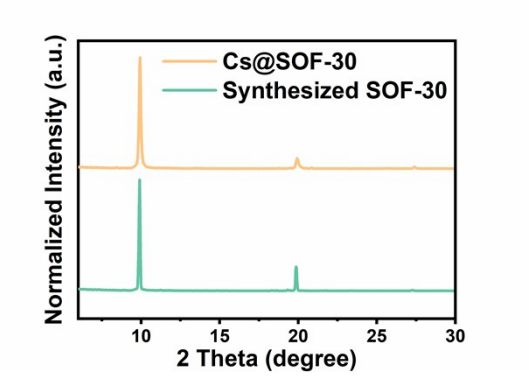

Figure S10. Powder X-ray diffraction (PXRD) patterns of **Cs@SOF-30**.

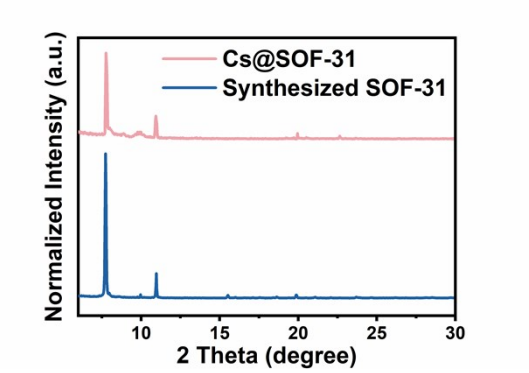

Figure S11. Powder X-ray diffraction (PXRD) patterns of **Cs@SOF-31**.

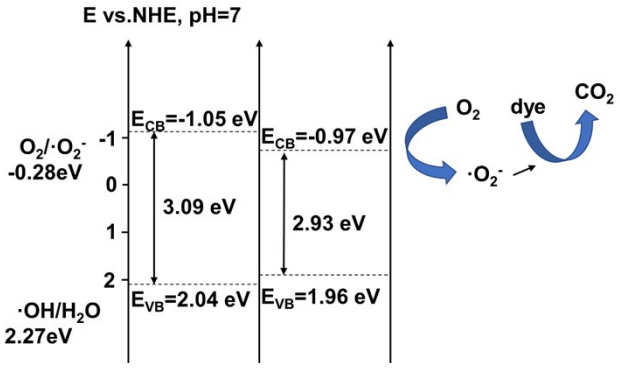

Figure S12. Schematic representation of the band-edge positions of in **SOF-30** and **SOF-31**.

Let take **SOF-30** as example. The minimum of CB in **SOF-30** is negative than $E_{O^2/\cdot O^{2-}}$ (-0.28 V vs. NHE, pH=7). When the electrons are excited from the valence band (VB) to the CB under light irradiation, the photogenerated electrons can capture surface chemically adsorbed O_2 molecules to yield the superoxide radical $\cdot O_2^-$, which could further participate in the degradation of dye molecules. In addition, the VB is positive than $E_{\cdot OH/H2O}$ (+2.27 V vs. NHE, pH=7), the holes in VB can oxidize H_2O molecules to yield reactive ·OH species. These reactive radicals contribute to the degradation of dye to H_2O and CO_2 as the final products.

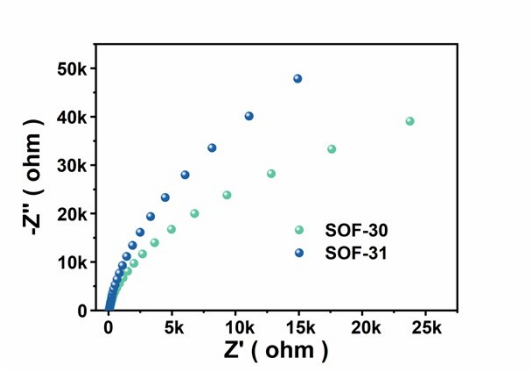

Figure S13. EIS Nyquist plots of **SOF-30** and **SOF-31** electrodes.

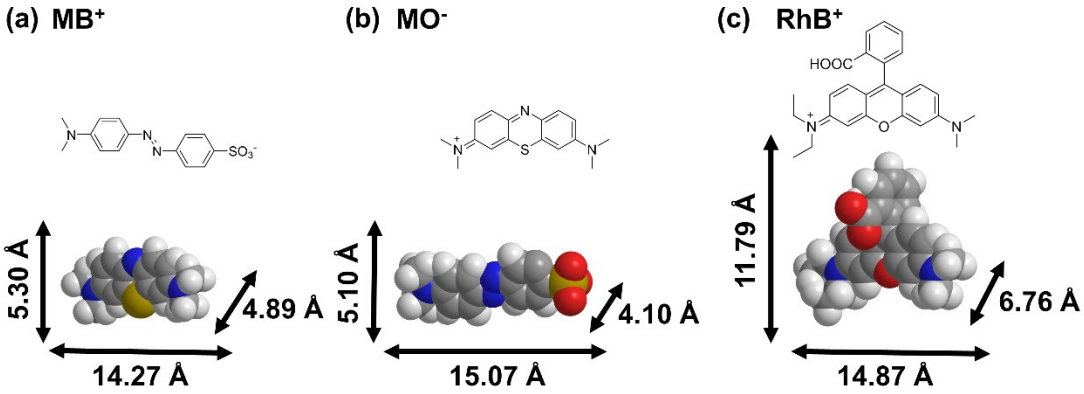

Figure S14. Chemical structures and dimensions (Å) of different dye molecules.

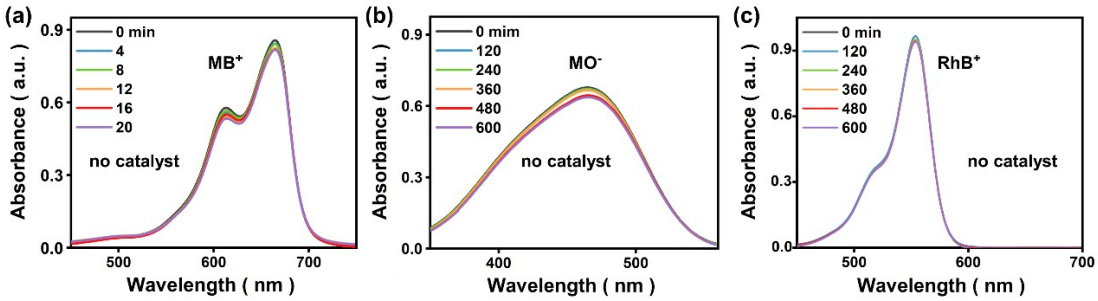

Figure S15. Absorbance under the photocatalytic degradation conditions without catalyst for MB^+ (a), MO^- (b) and RhB^+(c).

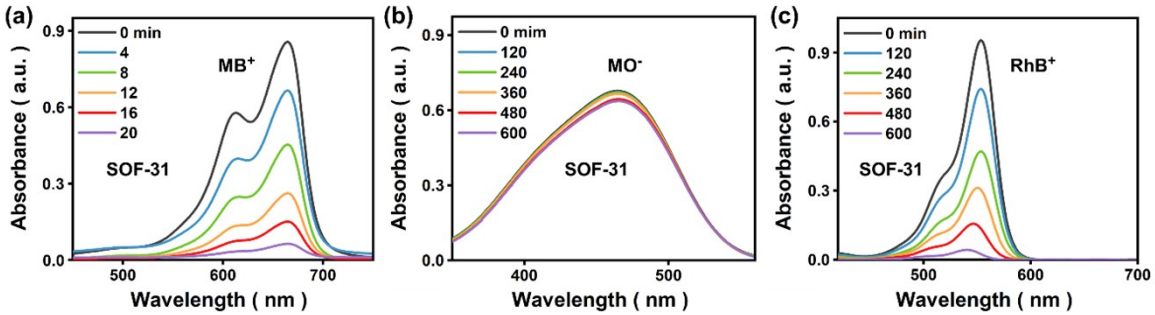

Figure S16. Absorbance under the photocatalytic degradation conditions of **SOF-31** for MB^+ (a), MO^- (b) and RhB^+(c).

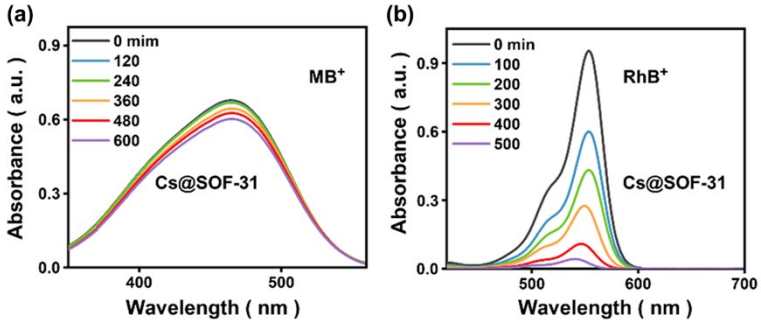

Figure S17. Absorbance under the photocatalytic degradation conditions of **Cs@SOF-31** for MB^+ (a)and RhB^+(b).

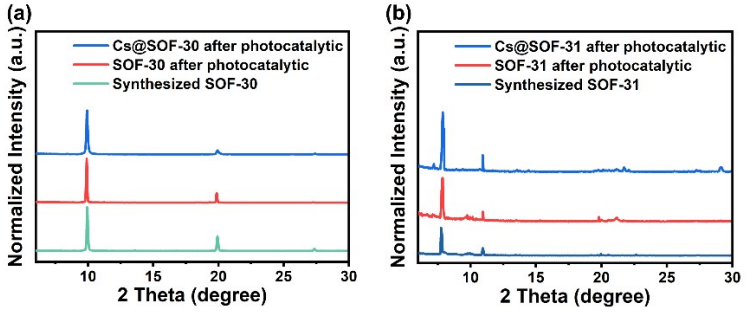

Figure S18. PXRD patterns of as-synthesized **SOF-30** and **Cs@SOF-30** (a); **SOF-31** and **Cs@SOF-31** (b) after photocatalytic experiment.

Table S1. Crystal data and refinement results of **SOF-30** and **SOF-31**.

Compounds	**SOF-30**	**SOF-31**
Framework formula	$[In_4Sn_2S_{12}]$	$[In_5Sn_3S_{17}]$
Formula weight	1081.38	1494.54
Crystal system	Monoclinic	Orthorhombic
Z	4	4
Space group	$P2_1/c$	*Pccn*
a (Å)	13.0435 (7)	23.9507 (16)
b (Å)	35.1784 (17)	12.4142 (9)
c (Å)	10.3323 (5)	22.5931 (16)
α (°)	90	90
β (°)	91.933 (2)	90
γ (°)	90	90
V(Å^3)	4738.3 (4)	6717.6 (8)
T(K)	119.89	119.99
F(000)	1952.0	2688.0
D(g/cm^{-3})	1.516	1.478
Collected reflections	46448	34257
Independent reflections	8658	6452
GOF on F^2	1.042	1.008
R_1, wR_2(I>2σ(I))	0.0423,0.1095	0.0493,0.1390
R_1, wR_2(all data)	0.0580,0.1189	0.1289,0.1906

Table S2. Elemental analysis results of **SOF-30** and **SOF-31**.

	Elements (*wt.*)	**N (%)**	**C (%)**	**H (%)**
SOF-30	Calculated	6.35	20.08	3.20
	Experimental	6.42	19.78	3.20
SOF-31	Calculated	5.53	20.91	3.92
	Experimental	5.47	20.78	3.90